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Reduced serum IgE level in Nigerian children with helminthiasis compared with protozoan infection: Implication on hygiene hypothesis

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ABSTRACT

Parasitosis is a major health problem in Nigeria with 50% prevalence among urban dwellers and 68% prevalence among rural population. Serum IgE differs with allergy and chronicity of infection but information on IgE levels in humans with different classes of parasites is scarce. Stool and blood specimens collected from apparently healthy, asymptomatic, school children were examined for ova, cysts and larvae of intestinal parasites and for trophozoites of *Plasmodium* species respectively. Serum IgE level was measured by ELISA method while stool examination and malaria parasite examination were carried out microscopically by wet preparation and thick film respectively. 64(74%) children had helminthic infection while 23(26%) had protozoan infection. The mean serum level of IgE was significantly elevated in children with helminthiasis or protozoan infection compared with control. Also, there was a significant reduction in mean IgE level in children with helminthiasis compared with protozoan infection. It is therefore suggested that IgE participates in protection against parasitic infections and that serum IgE level may be used to differentiate helminthiasis from protozoan infection.

Key words: Children, Helminthiasis, Hygiene hypothesis, Immunoglobulin E, Protozoan.

INTRODUCTION

Children especially in rural areas have high rates of parasite infestations due to poor sanitation, contact with contaminated water supply, low level of education and malnutrition [1, 2]. Infection and malnutrition have a synergistic association and both negatively affect the immune system [3, 4].

Immunoglobulin E (IgE) is present in trace amount in normal serum and has very short half-life (2-5 days). Its serum concentration is typically increased during infection with certain parasites [5, 6]. IgE is one of the 5 classes (isotypes) of antibodies. Like other immunoglobulins, it is produced by B cells and plasma cells. In contrast to other immunoglobulins, the circulating concentration of IgE is very low because B cells synthesize it at a very low rate and mast cells, basophils, and activated eosinophils bind up most of the circulating IgE [5]. The normal concentration of IgE is 0.05% of the IgG concentration [5]. In industrialized countries, allergy is the most common cause of elevated IgE concentrations, whereas in developing countries, parasitic infection is the most common etiology [5, 6]. An elevated IgE concentration supports the diagnosis of an allergic or parasitic disorder, but a normal IgE concentration does not exclude the diagnosis [5, 6]. A previous study [6] among healthy Nigerians reported increased IgE levels during parasitosis but the study did not consider the possible influence of different classes of parasites on IgE level. Our present study is therefore designed to provide information, for the first time, on

serum levels of IgE in Nigerian children with different classes of parasites with a view to determining whether serum IgE level could differentiate children with helminthiasis from protozoan infection.

MATERIALS AND METHODS

Ethical approval was obtained from UI/UCH ethic committee and informed consent from the parents of the children. Venous blood (5mL) was collected into plain bottles, spun following proper retraction and serum separated. Enzyme linked Immunosorbent Assay (Leinco Tech. Inc, USA) was used in determining the levels of IgE in the serum. The assay system utilizes two unique antibodies (a mouse monoclonal and a goat polyclonal) directed against distinct antigenic determinants on the IgE molecule. Into the plastic microtiter wells coated with anti-IgE (mouse monoclonal) was added test samples/controls containing IgE to form immune complexes. Anti-IgE (goat polyclonal) enzyme-labeled with horseradish peroxidase was added to each well and incubated for 45 minutes at room temperature, the IgE molecule in the sample was sandwiched between the solid phase and enzyme-labeled antibodies. The wells were emptied and washed thrice to remove unbound-labeled antibody. An enzyme chromogen was added to the wells and incubated for 15 minutes at room temperature resulting in the development of a blue colour. A stop solution was added to each well and the intensity of the developed yellow colour is directly proportional to the concentration of IgE in the sample. This was read at 450nm wavelength.

Stool specimens from 96 children were examined for ova, cysts and larvae of intestinal parasites and their blood for trophozoites of *Plasmodium species*. Stool examination and malaria parasite examination were carried out microscopically by wet preparation and thick film respectively. Two stool specimens per subject was collected at one week interval and examined for intestinal parasites within an hour of collection.

All data were expressed as mean \pm standard error (S.E). Results were analysed using the Student t- test. Differences between mean values in subjects and controls were accepted as significant at 5% ($P \leq 0.05$) level.

RESULTS

The total prevalence of helminthiasis in the children was 74% and that of protozoan infections was 26%. Of the helminthes, *Ascaris lumbricoides* has the highest prevalence (45%) and *Trichuris trichuria* has the least prevalence (1%) whereas *Plasmodium species* has higher prevalence (18%) than *Entamoeba histolytica* among protozoan as shown in Table 1. The mean serum level of IgE was significantly raised in children with helminthiasis or protozoan infection ($p < 0.05$). Also, there was significantly reduced mean IgE level in the children infected with helminthes compared to protozoan (Table 2). In contrast, the level of IgE was insignificantly reduced in children with *Ascaris lumbricoides* compared with *Plasmodium species*.

Table 1: Percentage prevalence of parasites in school children.

Helminthes		Protozoan	
<i>Ascaris lumbricoides</i>	45%	<i>Plasmodium species</i>	18%
Hookworm	14%	<i>Entamoeba histolytica</i>	8%
<i>Taenia species</i>	14%		
<i>Trichuris trichuria</i>	1%		
Total	74%		26%

Table 2: Mean serum level of IgE in children with helminthiasis, protozoan infection and controls.

	Helminth (n=64)	Protozoan (n=23)	Control (25)	P-value
IgE (IU/ml)	304.38 \pm 192.84* [#]	363.26 \pm 183.37*	91.60 \pm 37.71	0.001

*Significantly different from control ($p \leq 0.05$)

[#]Significantly different from protozoan infection ($p \leq 0.05$)

Table 3: Mean serum level of IgE in Nigerian children infected with *Ascaris lumbricoides* and *Plasmodium species*.

	<i>Ascaris lumbricoides</i> (n=39)	<i>Plasmodium species</i> (n=16)	P-value
IgE(IU/ml)	293.08 \pm 205.33	324.37 \pm 190.29	>0.05

Significant at $p \leq 0.05$

DISCUSSION

Serum IgE level increases in atopic diseases, neoplasms, immunodeficiencies, viral and parasitic infections [7, 8]. Moreover, its concentration is also affected by age, sex, race, smoking habits and socioeconomic conditions [5, 9, 10] and may also vary from country to country [8, 10]. Previous studies concentrated on serum IgE levels in non-Nigerians only [5, 11, 12, 13]. Some of these investigators observed increased IgE concentration in patients with worm infections than those of protozoan [7]. This is contrary to our result where IgE level was found to be significantly higher in protozoan infection than helminthic infection. It is likely that the severity and the type of parasitosis are different between the studies.

Increased serum IgE level was observed in children with helminthic or protozoan infection compared with uninfected controls. It has been reported that IgE dependent mast cell reaction has evolved primarily to localize eosinophils near parasites to enhance anti-parasitic effects [5] using extracellularly diffused proteolytic substances from granules. It may be hypothesized that direct contact of protozoans with immune cells may stimulate polyclonal IgE synthesis than helminthes which are mostly restricted to intestines and other organs.

Acute infections are seen mostly in children and are associated with a mixed Th1/Th2 cytokine profile and high levels of IgE most of which is parasite-specific [13]. Chronic infections are characterized by a shift of Th2, high levels of parasite specific IgG4, and extremely high levels of total IgE, of which only a fraction is parasite-specific [13]. These high levels of non-specific IgE may supersaturate mast cells with impotent IgE promoting a decrease in allergic symptoms which might occur if there were free receptors available. This study therefore proposed protective role of protozoan infection against allergy and asthma. This involvement of protozoa in hygiene hypothesis needs further investigation.

In conclusion, parasitosis increases the level of IgE in children, and also the level of IgE might differentiate children with helminthiasis from protozoan infection.

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